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Gamma lines from K^{43}

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With 2 figures in the text

The decay of K^{43} ($T_{1/2} = 22.0^h$) to Ca^{43} has been investigated by Lindqvist and Mitchell [1], who reported five beta groups of the energies 1.839, 1.218, 0.927, 0.460 and 0.243 MeV and five gamma lines having energies 369, 627, 219, 393 keV and 1.00 MeV. The energy differences between the beta groups and coincidences between 369 keV and 627 keV transitions made these authors propose the level scheme of Fig. 1. A following experiment on the decay of Sc^{43} to Ca^{43} indicated [2] that there also existed a level at 369 keV above the ground state. The levels in Ca^{43} thus found agreed within error limits with a (d,p)-experiment on Ca^{42} by Braams [3]. However, refined experiments by Braams made it doubtful whether the gamma lines in the decay of K^{43} were put in the right order by Lindqvist and Mitchell. The level energies given by Braams [4] were 373, 593, 991, 1394 and 1678 keV.

The present work involves redetermination of the gamma energies with a precision spectrometer and γ-γ-coincidence experiments. K^{43} was obtained as a spallation product from bombarding vanadium with 190 MeV protons [5] in the synchrocyclotron of the Werner Institute, Uppsala. A considerable amount of K^{42} ($T_{1/2} = 12^h$) was simultaneously produced.

The energy measurement of the two strongest gamma lines was carried out in a double focusing beta spectrometer ($r = 50$ cm) by recording the photo lines from a 14 mg/cm^2 lead foil. By using the 560.5 keV line of As^{76} as a standard [6] we obtained

$$\gamma_1 = 373.7 \pm 0.4 \text{ keV}, \qquad \gamma_2 = 618.9 \pm 0.6 \text{ keV}.$$

From the point of view of energies there is no doubt that, in the level scheme due to Braams, these transitions should be placed as a cascade leading to the ground state.

In a carefully calibrated scintillation spectrometer the high energy gamma line was determined to 1.02 ± 0.1 MeV. It can accordingly be concluded that this line is not a crossover to the 619 and 374 keV lines. The weak 393 keV line was not recorded in the beta-spectrometer, its intensity being too low and not in the scintillation spectrometer because of the energy, too close to the strong 374 line. The weak 219 keV line was found in the coincidence experiment (see below) but the energy could not be accurately measured.

The coincidence experiments were carried out with a conventional coincidence scintillation spectrometer having an effective resolving time of 1×10^{-7} s. It was found that the 374 keV line was in coincidence with 1.02 MeV, 619 keV and 219 keV

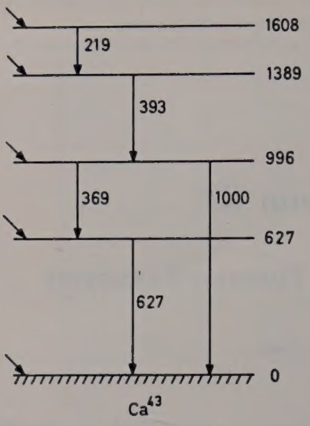

Fig. 1.

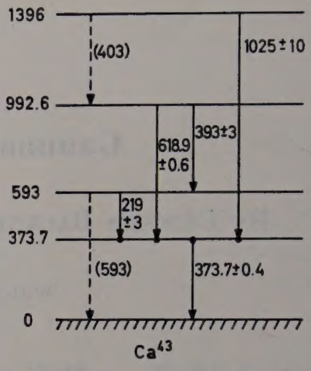

Fig. 2.

lines. Further, the 619 keV line was in coincidence only with the 374 keV line. The 1.02 MeV line was in coincidence only with the 374 keV line. This information led us to put the gamma lines into the level scheme of Ca^{43} as shown in Fig. 2, in good agreement with a recent experiment by C. S. Wu *et al.* [7].

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